INSTRUCTIONS

MODEL AVX-D-4A-PS-OP1-LIB

5 V, 1.5-30 μs
DUAL CHANNEL
DELAY GENERATOR

SERIAL NUMBER: _____

WARRANTY

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INTRODUCTION

The AVX-D-4A-PS-OP1-LIB delay generator provides two output channels which are delayed in the range of 1.5μs to 30μs, when triggered by a TTL-level input pulse. The two channels have equal delays, but have separate pulse width and amplitude controls. The output pulse widths may vary from 0.5μs to 5μs. The output amplitudes may vary from 0 to +5V. The AVX-D-4A-PS-OP1-LIB will drive 50Ω loads, and has a 50Ω output impedance. The output rise and fall times are 10 ns or less.

The delay and pulse widths can be controlled either by the front-panel controls, or via the GPIB IEEE-488 computer interface. The control method is selected by a switch on the back panel of the AVX-D-4A-PS-OP1-LIB. The output amplitudes are controlled by front-panel controls only.

SPECIFICATIONS

Model:	AVX-D-4A-PS-OP1-LIB
Delay:	1.5μs to 30μs. Controlled by a ten turn control or by the GPIB. Accuracy ±100ns ±1.5% of delay (±3% if delayed by more than 70% of the period) 120ns resolution. May be delayed up to 85% of the period.
Output pulse width (for OUT A and OUT B):	0.5 to 5μs. Controlled by two ten turn controls or by the GPIB. Accuracy 25ns ±3% of PW. 20ns resolution.
Output amplitude (for OUT A and OUT B):	0 to +5V to R_L = 50Ω Controlled by two front panel one-turn controls.
Delay (relative to SYNC output):	50 ns to 50 μs
Jitter:	±100 ps RMS (delay and PW)
Output rise time, fall time:	≤ 10 ns
Input trigger:	+5 Volts, ≥ 50 ns TTL
PRF:	10 kHz to 100 kHz
Pulse width/delay update time:	≤ 30 ms
Signal connectors:	BNC
Power requirement:	120/240 Volts (switchable), 50 - 60 Hz
Dimensions:	3.9” x 17” x 14.8”. Includes 19" rack mount kit.
Temperature range:	+10° C to +40° C

INSTALLATION

VISUAL CHECK

After unpacking the instrument, examine to ensure that it has not been damaged in shipment. Visually inspect all connectors, knobs and the handles. Confirm that a power cord and instrumentation manual are with the instrument. (If the instrument has been damaged, file a claim immediately with the company that transported the instrument).

PLUGGING IN THE INSTRUMENT

Examine the rear of the instrument. There will be a male power receptacle, a fuse holder and the edge of the power selector card visible. Confirm that the power selector is in the correct orientation - it should be marked either 120 or 240, indicating whether it expects 120V AC or 240V AC. If it is not set for the proper voltage, remove the fuse and then grasp the card with a pair of pliers and remove it. Rotate horizontally through 180 degrees. Reinstall the card and the correct fuse. In the 120V setting, a 1/2A slow blow fuse is required. In the 240V setting, a 1/4A slow blow fuse is required.

OPERATIONAL CHECK

This check is to confirm that the instrument is fully operational. Set the controls to the following values:

- DELAYcontrol: fully counter-clockwise (minimum delay)
- PULSE WIDTH A control: fully counter-clockwise (minimum pulse width)
- PULSE WIDTH B control: fully counter-clockwise (minimum pulse width)
- AMPLITUDE A control: fully clockwise (maximum amplitude)
- AMPLITUDE B control: fully clockwise (maximum amplitude)
- REMOTE/LOCAL switch (on the rear panel): LOCAL

Connect a pulse generator or other signal source with a 20 kHz frequency, a pulse width of at least 50ns, and TTL logic levels (0 and 5V) to the IN input connector. (The voltage applied to this input must not go below zero volts, or exceed +5V.) Connect an oscilloscope probe to this input, and view it on the oscilloscope. Trigger the oscilloscope from this signal.

Connect a 50Ω, 2 Watt load between the OUT A connector signal line and ground. Connect a second oscilloscope probe to the OUT A output.

Set the oscilloscope vertical scale at 2 Volts/div and the horizontal scale at 5 μs/div. Then follow the instructions below and compare what is seen on the oscilloscope to what is described. Only approximate values are needed to confirm operation.

STEP	CONTROL	OPERATION	RESULTS
1	POWER	Push in (on) and wait for a 5 minute warm-up period.	OUT A has +5V amplitude and 0.5μs pulse width, and is delayed 1.5μs relative to the trigger pulse.
2	DELAY control	Rotate fully clockwise	The OUT A delay increases to 30μs.
3	PULSE WIDTH A control	Rotate fully clockwise	The OUT A pulse width increases to 5μs.
4		Remove the load and probe from OUT A and attach to OUT B	OUT B has +5V amplitude and 0.5μs pulse width, and is delayed 30μs relative to the trigger pulse.
5	PULSE WIDTH B control	Rotate fully clockwise	The OUT B pulse width increases to 5μs.

Steps 1 to 5 confirm that the pulse delay, pulse width, and amplitude controls are functioning properly.

Step 6 and 7 are optional, and are to confirm that the GPIB interface is operating.

6	REMOTE/LOCAL switch (on rear panel)	Set at "REMOTE"	OUT B has +5V amplitude and 0.5μs pulse width, and is delayed 1.5μs relative to the trigger pulse.

In the absence of computer commands, the AVX-D-4A-PS-OP1-LIB defaults to the minimum pulse widths and delays when in the REMOTE mode. This is demonstrated by step 6.

To fully test the instrument's REMOTE mode, a computer with a properly-configured GPIB controller card and the appropriate software is required. Connect the controller to the AVX-D-4A-PS-OP1-LIB's rear-panel GPIB connector using the supplied GPIB cable. The AVX-D-4A-PS-OP1-LIB is shipped with its GPIB address set at "8". Send the following three commands to the AVX-D-4A-PS-OP1-LIB via the GPIB bus:

A2
B4

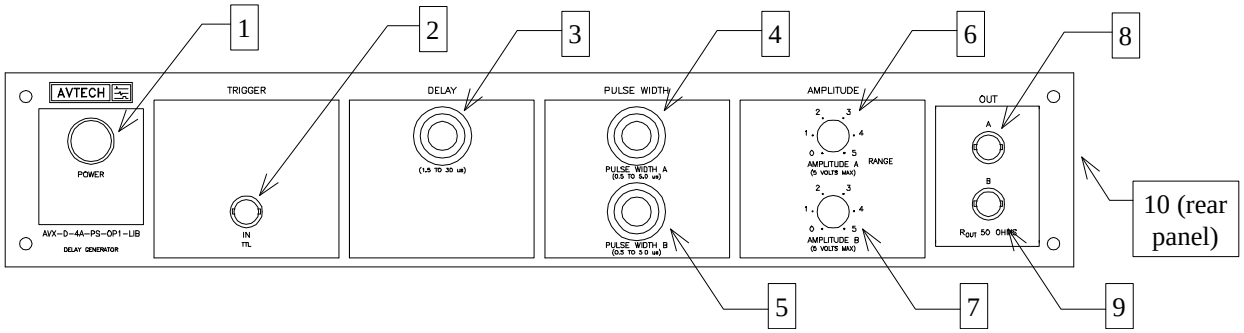
D20

Then observe the output on the oscilloscope.

7	GPIB interface.	Send GPIB commands.	OUT A has +5V amplitude and 2μs pulse width, and is delayed 20μs relative to the trigger pulse. OUT B has +5V amplitude and 4μs pulse width, and is delayed 20μs relative to the trigger pulse.

This completes the operational check.

FRONT PANEL CONTROLS



(1) POWER switch. The POWER pushbutton switch applies AC prime power to the primaries of the transformer, turning the instrument on.

(2) IN connector. The instrument is triggered by an external TTL-level trigger pulses applied to this connector. Note that this is a high-impedance input; it is not terminated in 50Ω.

(3) DELAY control. When the Remote/Local Switch (item 10) is in the "Local" position, this controls the delay between the input pulse (on connector 2) and the two output pulses (on connectors 8 and 9). The delay can be varied between 1.5 μs and 30 μs.

(4) PULSE WIDTH A control. When the Remote/Local Switch (item 10) is in the "Local" position, this controls the output pulse width on the "A" channel (connector 8). The pulse width can be varied between 0.5 μs and 5 μs.

(5) PULSE WIDTH B control. When the Remote/Local Switch (item 10) is in the "Local" position, this controls the output pulse width on the "B" channel (connector 9). The pulse width can be varied between 0.5 μs and 5 μs.

(6) AMPLITUDE A control. This varies the output amplitude of the "A" channel (connector 8) between 0 and +5 Volts.

(7) AMPLITUDE B control. This varies the output amplitude of the "B" channel (connector 9) between 0 and +5 Volts.

(8) OUT A connector. This connector provides the "A" channel output. It will supply up to +5V into 50Ω. The output impedance is 50Ω.

(9) OUT B connector. This connector provides the "B" channel output. It will supply up to +5V into 50Ω. The output impedance is 50Ω.

(10) REMOTE/LOCAL switch. When this switch is in the "LOCAL" position, the pulse delay and pulse widths are controlled by controls (3), (4), and (5). In the "REMOTE"

position, these parameters are controlled by a computer via the GPIB interface, and (3), (4), and (5) have no effect.

GENERAL INFORMATION

BASIC PULSE CONTROL

This delay generator is triggered an external TTL signal. Two output channels respond to the trigger: OUT A and OUT B. The two output channels are delayed by the same amount, but they can have different pulse widths and amplitudes. This relationship is illustrated below:

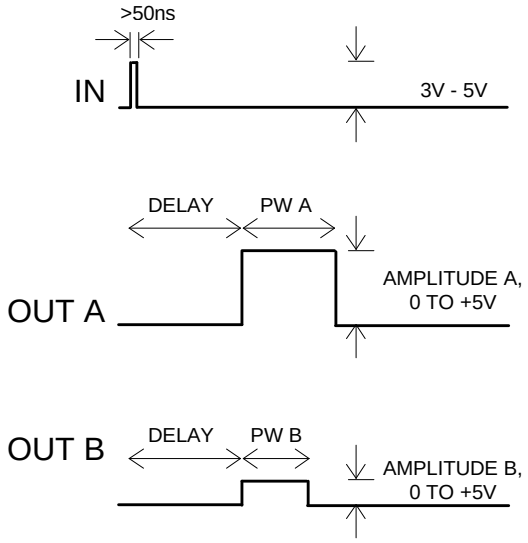


Figure 4 - Basic Output Pulses

The delay and pulse widths can be varied with front panel controls or via the GPIB computer interface. The amplitude can be set using the front panel controls only.

ELECTROMAGNETIC INTERFERENCE

To prevent electromagnetic interference with other equipment, all used outputs should be connected to shielded 50 Ohm loads using shielded 50 Ohm coaxial cables. Unused outputs should be terminated with shielded 50 Ohm BNC terminators or with shielded BNC dust caps, to prevent unintentional electromagnetic radiation.

TOP AND BOTTOM COVER REMOVAL

The top cover of the instrument may be removed by removing the four Phillips screws on the top panel. With these four screws removed, the top panel may be slid off by pulling it towards the rear. The bottom panel may be similarly removed.

USER-ACCESSIBLE INTERNAL ADJUSTMENTS

Several trimming potentiometers and capacitors are accessible inside the instrument to adjust the delay and pulse width accuracies. These controls can be accessed by removing the top panel, and by locating the blue module closest to the front panel of the instrument.

For each of DELAY, PW A, and PW B, there are two trimming controls. The "RANGE" trimmers adjusted the maximum/minimum ratio of the respective controls. For instance, the max/min ratio of DELAY is ideally 30μs/1.5μs=20. The max/min ratio of PW A and PW B is ideally 5μs/0.5μs=10. Once the "RANGE" trimmer has been set, the "MAX" trimmer sets the maximum value of the control.

Note: The screw slots of the "MAX" trimmers are electrically active, so a non-conductive screw-driver should be used to perform the adjustments. Do not short the screw slots to the case with the screw-driver. (No dangerous voltages are present on the trimmers, however.)

To calibrate all of the controls, perform the following steps:

1. Set the "REMOTE/LOCAL" switch to "LOCAL".

2a. Set the DELAY control fully counter-clockwise. The resulting delay should be approximately 1.5μs. Record this value.

2b. Set the DELAY control fully clockwise. The resulting delay should be approximately 30μs. Record this value.

2c. If the ratio of the value found in step 2b to the value found in step 2a is not 20.0, adjust the "DELAY RANGE" trimmer and repeat steps 2a and 2b until it is.

2d. Set the DELAY control fully clockwise. Adjust the "DELAY MAX" trimmer until the delay is exactly 30.0μs.

2e. Set the DELAY control fully counter-clockwise. The delay should be 1.50μs. If it is not sufficiently close to this, repeat steps 2a-2e iteratively until it is.

3a. Set the PW A control fully counter-clockwise. The resulting OUT A pulse width should be approximately 0.5μs. Record this value.

3b. Set the PW A control fully clockwise. The resulting OUT A pulse width should be approximately 5μs. Record this value.

3c. If the ratio of the value found in step 3b to the value found in step 3a is not 10.0, adjust the "PW A RANGE" trimmer and repeat steps 3a and 3b until it is.

3d. Set the PW A control fully clockwise. Adjust the "PW A MAX" trimmer until the OUT A pulse width is exactly 5.0μs.

3e. Set the PW A control fully counter-clockwise. The OUT A pulse width should be 0.50μs. If it is not sufficiently close to this, repeat steps 3a-3e iteratively until it is.

4a. Set the PW B control fully counter-clockwise. The resulting OUT B pulse width should be approximately 0.5μs. Record this value.

4b. Set the PW B control fully clockwise. The resulting OUT B pulse width should be approximately 5μs. Record this value.

4c. If the ratio of the value found in step 4b to the value found in step 4a is not 10.0, adjust the "PW B RANGE" trimmer and repeat steps 4a and 4b until it is.

4d. Set the PW B control fully clockwise. Adjust the "PW B MAX" trimmer until the OUT B pulse width is exactly 5.0μs.

4e. Set the PW B control fully counter-clockwise. The OUT B pulse width should be 0.50μs. If it is not sufficiently close to this, repeat steps 4a-4e iteratively until it is.

USING THE GPIB INTERFACE

The AVX-D-4A-PS-OP1-LIB incorporates the Avtech OP1 "GPIB bus listener interface". This section describes how to use the IEEE 488 General Purpose Interface Bus (GPIB) for remote computer control of the AVX-D-4A-PS-OP1-LIB.

INTERFACE TO THE GPIB

The Avtech OP1 interface is a simple "listener" interface for the GPIB. It will receive simple commands from a computer over the GPIB bus, but it does not have the capability to send any data back to the computer. In more concise terms, the OP1 interface implements the following IEEE 488.1 Capabilities as defined in the IEEE 488.1 Standard:

SH0	no "Source Handshake" capability (can not send information)
AH1	complete "Acceptor Handshake" capability (can receive information)
T0	no "Talk" capability (can not send information)
TE0	no "Talk Extended" capability (can not send information)
L2	basic "Listen" capability (can receive information)
LE0	no "Listen Extended" capability (because it is a basic listener only)
SR0	no "Service Request" capability (because it is a basic listener only)
RL0	"Remote/Local" switching controlled by a back panel switch (not computer controlled)
PP0	no "Parallel Poll" capability (because it is a basic listener only)
DC0	no "Device Clear" capability (can not be remotely reset)
DT0	no "Device Trigger" capability (can not be triggered by the computer)
C0	no "Controller" capability (because it is a basic listener only)

AVAILABLE COMMANDS

The OP1 GPIB user interface is designed to be used to remotely program the Avtech pulse generator to control the delay and pulse widths.

The available commands, outputs, units and range of acceptable values for the AVX-D-4A-PS-OP1-LIB generator are defined in the table below:

Command Acronym	Function	Units	Range
A	set A pulse width	μs	0.5 to 5
B	set B pulse width	μs	0.5 to 5
D	set Delay	μs	1.5 to 30

COMMAND INTERPRETATION

The command may utilize the defined single letter acronym, or may be expanded to a longer word to make the control program easier to understand. This is because letters following the defined acronym letter are ignored. For example, a command of "D2" will cause exactly the same result if the command is sent as "delay of output pulse = 2". However, it is mandatory that the first letter of each command be one of the four defined acronyms.

If desired, trailing text may be added to make the control program easier to understand, since it will be ignored. For example, a command of "delay=3" will result in the same output as the command "delay = 3 micro-seconds".

Acronyms are case insensitive, for example, "D" or "d" are the same.

The number following the acronym letter may be any number in the range specified, however, the number of significant digits are limited to one part in 255 (for 8 bits of output resolution). Numbers outside the specified ranges will be ignored.

Leading or trailing zeros in numbers will be ignored. Numbers expressed in "exponential" format will NOT be interpreted correctly. For example, 3e+2 will be interpreted as 3, not as 300.

If an invalid command is sent, the unit will ignore the command and the previous value will remain unchanged. If an "out-of-range" value is sent, the unit will also ignore the command.

TYPICAL COMMAND SEQUENCE INTERPRETATION

Assume the following commands are sent using the computer, using the appropriate command structure as specified for the user's GPIB controller. Note that the default GPIB address is eight.

A=1
B=2
D=4

For example, for a GPIB controller from National Instruments, the following set of commands would be sent:

```
ibwrt "a=1"
ibwrt "b=2"
ibwrt "d=4"
```

This command sequence will cause the generator to produce an output with A channel pulse width of 1μs, B channel pulse width of 2μs, and delay of 4μs.

CHANGING THE UNIT GPIB ADDRESS

The GPIB data bus address for the pulse generator has been preset to "8" in the factory. However, the user may wish to change the address to any address in the allowed range of 0 to 30. This address may be easily changed by re-setting the GPIB address switch on the GPIB Interface board located inside the pulse generator chassis.

The address is set by means of a five position "Dipswitch " located on the top of a small circuit card located inside the enclosure near the top rear. The switch may observed to be set to the default address by noting that the Dipswitch position 4 is set in the OFF position, defining a binary address of 8.

The switch setting is calculated as the sum of the switch weights in the OFF position, calculated as follows: (a switch in the ON position it has a weight of zero):

Switch Number	OFF Weight
1	1
2	2
3	4
4	8
5	16

For example, a switch with positions 1, 4 and 5 set to OFF will result in an address setting of 25 (16 plus 8 plus 1 = 25).

TROUBLE-SHOOTING AID

In the event that difficulties are encountered communicating via the GPIB interface, two auxiliary communications status indicators have been included on the GPIB interface circuit card. These status indicators are small LED lamps, one which flashes briefly whenever a properly addressed command is received. The second LED will light whenever an out-of-range value or invalid command is received, and will remain lit until a valid command with a valid in-range value is subsequently received.